



# Cooperative Multinational Industry/Government Project for Standardizing Munitions Automatic Test

NDIA Systems Engineering Supportability Conference San Diego, CA. October 2000



# **Session Background**



- The conference theme is "Strategies for Reducing Total Ownership Costs"
- This session highlights on-going activities in munitions support aimed directly at total ownership cost reduction
- The two primary approaches are:
  - Automatic Test Systems (ATS) Standardization
  - Cost Sharing across Services and Nations
- The team focussing on these approaches includes:
  - Department of Defense
  - Missile Manufacturers
  - FMS Customers



# **Navy Perspective**



- Munitions testing affects many programs throughout the Navy
- These programs are typically controlled by their own program offices
- These offices are generally segregated between NAVAIR and NAVSEA
- Integration of data, equipments and test philosophies across organizations and programs is difficult



# **NAVAIR Programs**

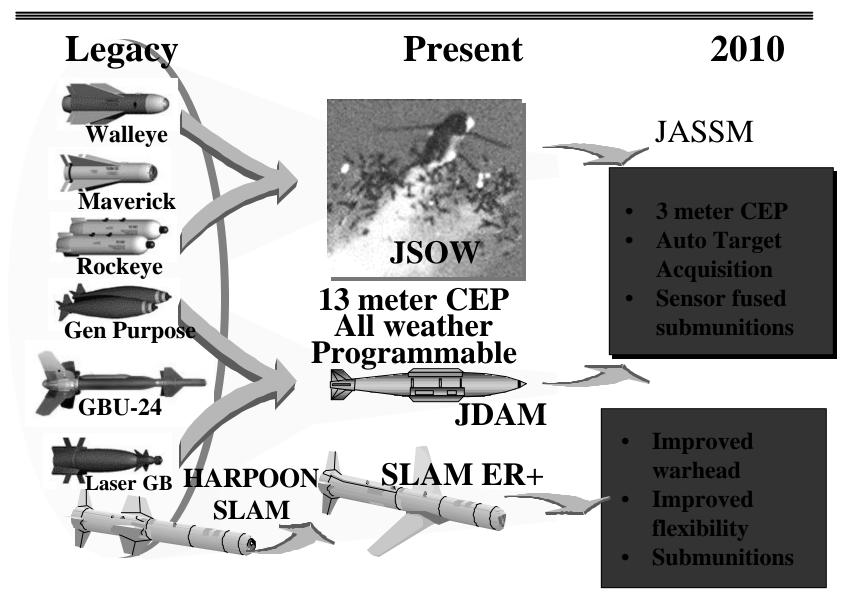


- At least eight NAVAIR Munitions Programs are affected by ATS support methods and costs:
  - PMA-259 Air-to-Air Programs
  - PMA-268 AMRAAM
  - PMA-201 Strike Weapons Programs
  - PMA-242 Defense Suppression Programs
  - PMA-258 Standoff Missile Systems Programs
  - PMA-280 Tomahawk All-Up-Round Programs
  - PMA-282 Cruise Missile Weapons System Programs
  - PMA-260 ATS Standardization





#### **Precision Guided Munitions**





# Defense Suppression SEAD/DEAD







**HARM** 

2005



**AARGM** 



**HARM** 



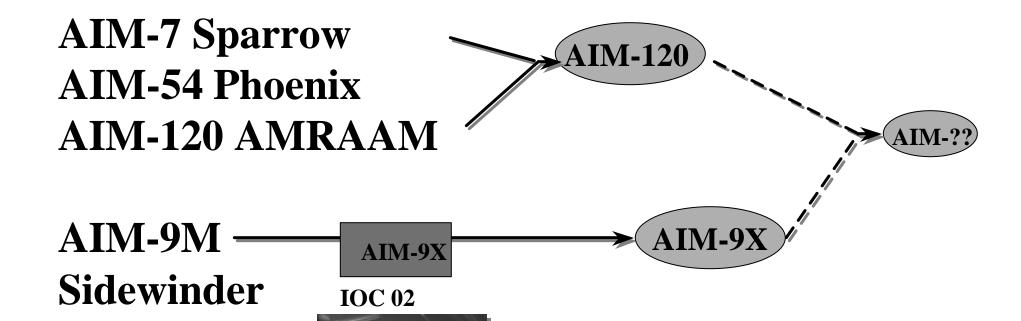
**AARGM** 

2010



#### **Air-to-Air Missiles**





**Helmet Mounted Cueing System** 



# **NAVSEA Programs**



#### At least nine NAVSEA munitions programs are affected by ATS support methods and costs

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    PMS-472 Rolling Airframe Missile (RAM) Program
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PMS-471 Evolved Seasparrow Missile Program

PMS-325 High Speed Anti-Radiation Missile/Infrared

PMS-429 Extended Range Guided Munition (ERGM)

PMS-422B5 Land Attack Standard Missile

PMS-451 Navy Area Theater Ballistic Missile Defense (TBMD)

PMS-452 Navy Theater Wide Ballistic Missile Defense (NTW)

PMS-422 Standard Missile 2 Blk III/IV Program

PMS-404 Vertical Launch ASROC (VLA)



#### **Surface-to-Air**



#### **Present**



NATO Seasparrow



SM-2 Blk III/IV



05/10



HARM IR

**RAM** 



**ESSM** 



**SM-4 LASM** 

SM-3 TBMD

**ERGM** 



#### **Current SE Posture**



- Joint Tactical Missile Depot moving from LEAD to TOAD
  - Support of Legacy weapons
  - Weapons SE twenty five years or older
- Intermediate level (NWS) drawdown to two sites (Yorktown, VA & Seal Beach/Fallbrook, CA)

Obsolete SE: DSM-130 Phoenix

DPM-21 Sparrow

MK-612 Standard Missile I, II

- OEM workload has increased "I" and "D" capability added using combination of factory and depot SE
  - Obsolete equipment with upgrades
  - Third party maintenance contracts
  - SE often covered as overhead on production contract (Facilities)



#### The Trend



- Growing realization that common FTE/SE across platforms more efficient
  - Efforts underway with DoD, NDIA
- Changing priorities, force structures, funding levels and weapons lifetimes are dictating examination of new support philosophies



#### **Drivers**



- Four major, interactive factors are beginning to influence philosophy changes, these are:
  - Performance-Based Business Environment (PBBE)
  - O-to-OEM Maintenance
  - Military Application of COTS
  - Multi-service/multi-national peacekeeping/strike force support (Interoperability)



#### 1. Performance-Based Business Environment



- Under a Performance-Based Business Environment (PBBE) DoD species requirements ("What must be done"), not method ("How to do it")
- In the limit this would include such items as:
  - Combat Aircraft acquired on a "flight-hours per year" basis
  - Missiles procured with warrantee provisions
- The impact is that maintenance testers, tools, methods and locations may be unspecified.
- "O-to-OEM" may be the order of the day
- COTS ATE will become more common in the military environment



#### 2. "O-to-OEM" Maintenance



- With fewer constraints on maintenance methods, prime item manufacturers will often opt for a two-level maintenance environment where failed items are replaced at the Organizational level and repaired at the manufacturers site
- Factory test equipment may become maintenance test equipment, and COTS will dominate the ATE arena
- Where field testing exists, traceability to and interoperability with factory testing will be desirable
- Commonality between factory test equipment and fielded ATE will also offer reductions in ownership costs
- Traceability and commonality will require unprecedented cooperation between industry and government if ATE proliferation is to be reduced
- Industry, not government, must drive test equipment standards



# 3. Military Application of COTS Equipment



- With a few exceptions, military test equipment quantity buys cannot support custom designs, particularly under current budgets
- In many instances, COTS equipment will satisfy performance and environmental needs
- COTS provides a cheaper solution but has shorter lifetimes (obsolescence) and encourages proliferation (wider supplier base)
- DoD needs to take advantage of COTS while minimizing proliferation and maximizing interoperability



#### 4. Multi-Service, Multi-National Support



- Down-turns in funding levels coupled with muti-service, multi-national deployment of peacekeeping and strike forces provides challenges and opportunities
- The challenges revolve around the need for interoperability between weapons, services and nations
- These same factors offer opportunities to share technology, support facilities and support and development costs



# **Approach**



- The session will offer insight into:
  - Vision Overview
  - Industry Standardization Process Guided Munitions Module
     Test
  - A Joint US/FMS Muntions ATS Standardization
  - A Common, COTS-based ATS architecture
    - Hardware
    - Software
  - A Program Example for Missile All-Up Round Testing
  - A Program Example for Aircraft Interface Testing





#### **SESSION PAPERS**

#### **OVERVIEW & VISION**

STANDARD TEST EQUIPMENT PLATFORM (MODULES)

**GWTS UPGRADE** 

COMMON ATS ARCHITECTURE

HARDWARE SOFTWARE

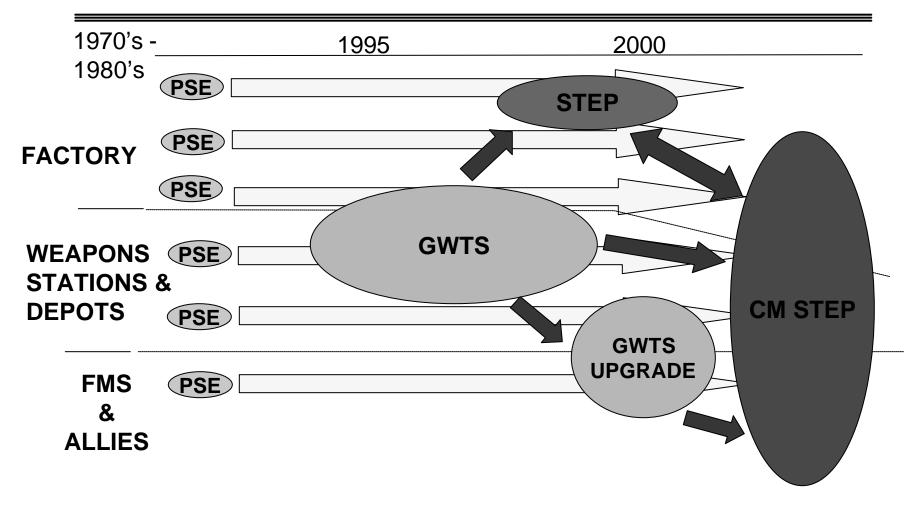
AIRCRAFT INTERFACE EXAMPLE

MISSILE AUR ATS EXAMPLE



# **CHRONOLOGY**







#### **BASIS OF ACTIVITY**



- The GWTS was developed by Raytheon under joint Navy/Air Force funding and managed by the AMRAAM JSPO
- The Standard Test Equipment Platform (STEP) is currently developed by Raytheon
- GWTS Upgrade is a joint USN Taiwan MND project managed by a Joint Overarching Integrated Product Team (JOIPT)
- Common Munitions Standard Test Equipment Platform (CM STEP) is a Raytheon initiative
- Raytheon/JOIPT collaboration is voluntary based on perceived mutual benefits





#### **SESSION PAPERS**



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STANDARD TEST EQUIPMENT PLATFORM (MODULES)

**GWTS UPGRADE** 

**COMMON ATS ARCHITECTURE** 

**HARDWARE** 

**SOFTWARE** 

AIRCRAFT INTERFACE EXAMPLE

MISSILE AUR ATS EXAMPLE



# Weapons ATS



# A Vision of Guided Weapons ATS Standardization-A Synergistic, Cooperative Approach

Clay Davis - NAVAIR, Research & Engineering
Mike Ellis - Test Automation Inc.
20 Sept 2000



# **Background**

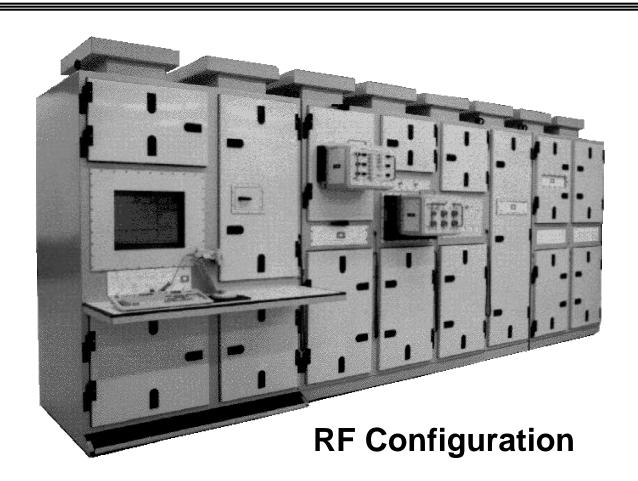


- Attempts to standardize weapons SE ongoing since 1985
- 1993 GWTS (AN/USM-659) award to Hughes (AMRAAM Joint Services Depot contract) - Specified test capability across 18 tactical guided weapons
- The same year OPNAV signed ORD for a standard missile test configuration
- Initial requirement for 71 systems CONUS
- Overcome by AR, BRAC, and maintenance changes(O-OEM)
- Budget cycles for user programs out of sync to acquire GWTS
- Seven stations delivered
  - 2 AMRAAM, 2 ESSM, 1 Taiwan, 1 JOIPT and 1 Spare





# **AN/USM-659 (V)1 GWTS**





## **GWTS Status**



- Current customer base AMRAAM, ESSM, Taiwan
- No immediate production requirement
- ORD rescinded, program decentralized to JOIPT April 1999



#### **DoD Current Focus Future Requirements**



- The current DoD environment revolves around funding reductions
- We are challenged to "...do more with less"
- We are also facing force restructures. Multi-national response teams are becoming the standard force mix
- A key initiative, Interoperability, is critical to meeting these challenges
- Standardization of Support Equipment (SE) is a proven method to reduce costs while improving interoperability



# Interoperability



- "Interoperability will be important to future warfare"
  - Joint Vision 2020, JCS
- "FMS cases are critical to U.S. interoperability with our foreign-nation allies"
  - Gen Lawrence F. Skibbie USA (Ret), President,
     NDIA
- Interoperability must exist at mission and maintenance levels
- Interoperable maintenance will require common support equipment



# **ATS Standardization Savings**



- DoD has already experienced, and documented significant savings from ATS standards
- The U.S. Navy estimated savings of over \$1.4 billion from their first generation ATS standard VAST
- The current generation ATS standard, CASS, is expected to save \$3.9 billion through its service life of 2014
- These savings come from cost sharing in several areas

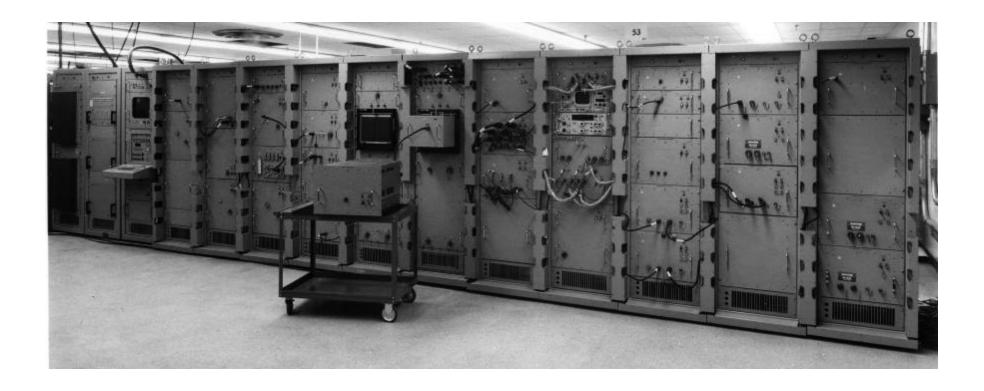
#### BUT -

Standardization across programs means resource(funding) sharing across programs



# **VAST**

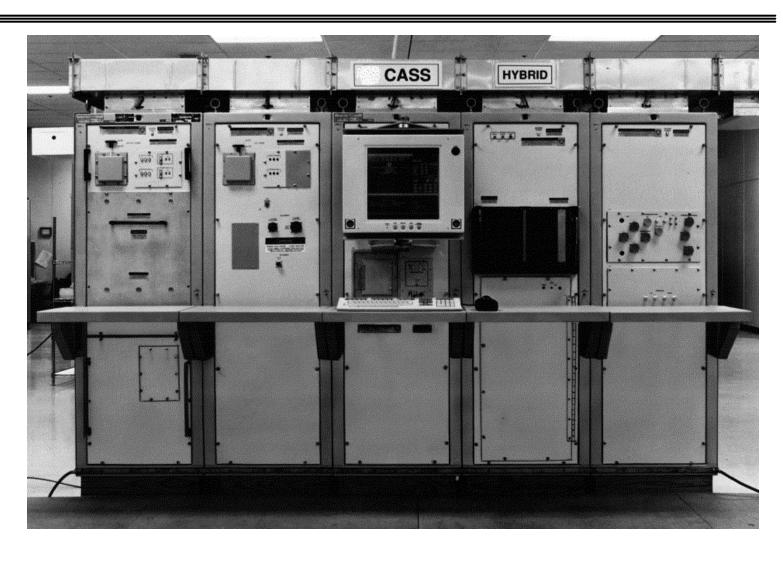






# **CASS**







# **TEAM** Support Life Cycle Costs (LCC)



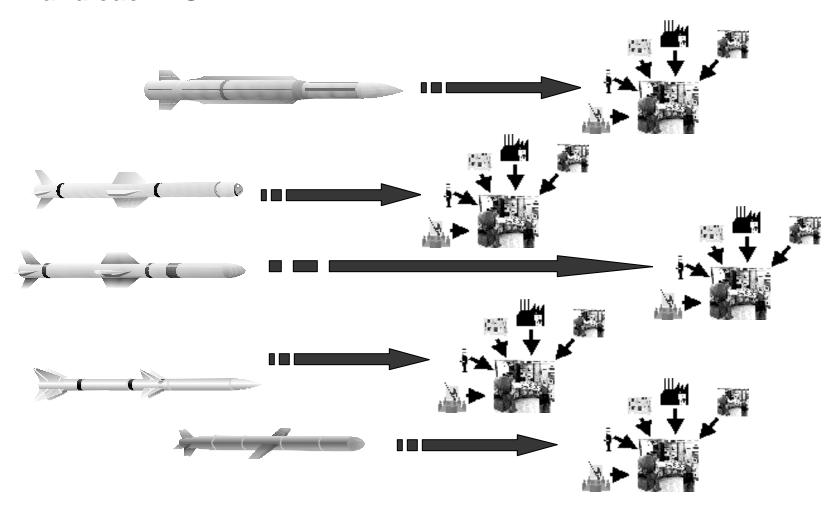
- Deployed ATE has Several Major Costs Throughout its Life
- These include:
  - ✓ Training
  - ✓ Maintenance
  - ✓ Spares
  - ✓ Contractor Support
    ✓ ATE & TPS Updates



# Peculiar Support Equipment (PSE) LCC



 The Life Cycle Costs Shown Previously Recur for each Weapon and each PSE

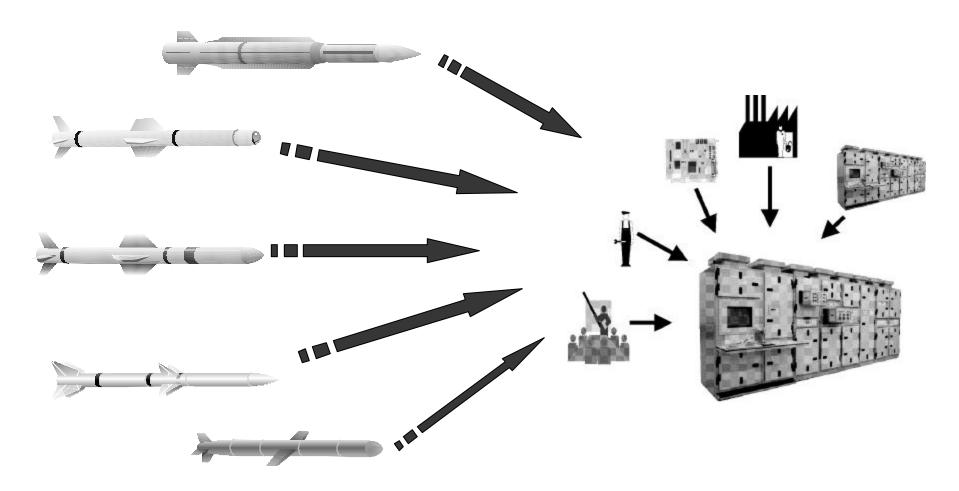




### **The Solution**



 Application of Standard ATE Eliminates PSE Proliferation and Reduces the Costs of all LCC Contributors





#### **FMS Needs**

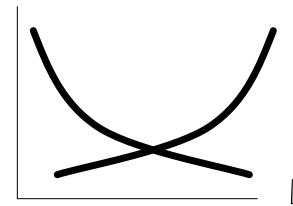


- FMS customers are experiencing the same peculiar ATS proliferation as DoD
- The need for ATS standardization is amplified since FMS customers typically have smaller quantities of each weapon, but still must buy each weapon's unique ATS
  - Many of these ATS are old
  - All are expensive
  - Lack of funding often forces ATS refurbishment, when replacement is really needed
- More money spent on ATS equates to less money spent on weapons which results in fewer weapons with a higher unit cost



#### The Problem





**Falling budgets** 

lead to

Increased Program Protectionism

Lower lead to Budgets

Refurbished Obsolete ATS

Lower Weapons Availability

Increased Support Cost per Weapon

**Lower Sales** 



# Roadblocks



- Roadblocks exist in several areas:
  - "Stovepipe" thinking
  - "Stovepipe" funding
  - FMS customers Vs FMS partners
- The paradigms in these areas require revision or replacement



# "Stovepipe" Thinking



#### The Roadblock:

 "My program budget has already been cut beyond recognition. I must protect what's left. I can't afford to share it with other programs"

#### The Reality:

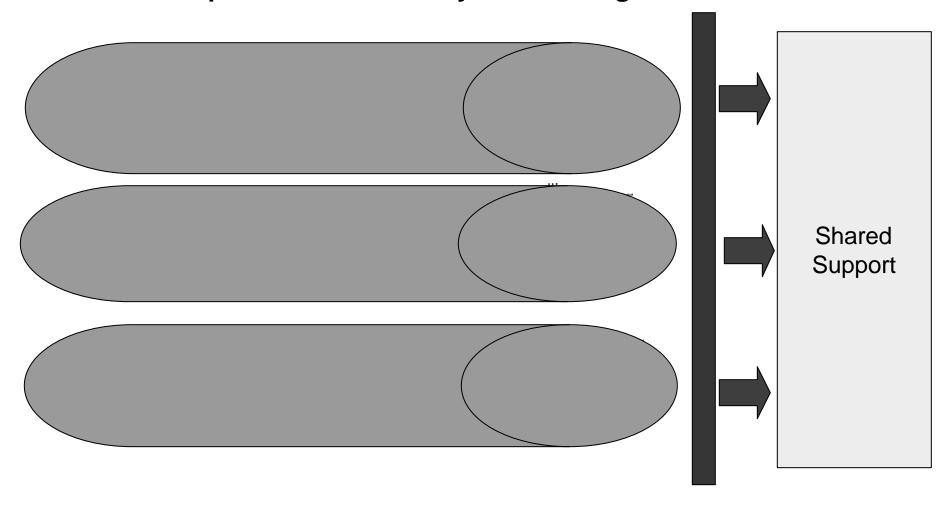
 Without resource sharing, many programs will become unexecutable. Yours may be one of them.



# Peculiar Support Equipment (PSE) LCC



What stops ATS commonality and sharing?

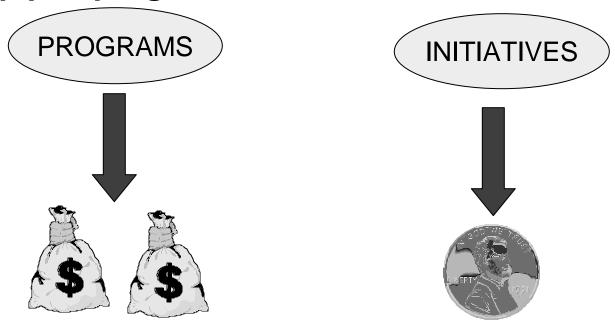




# "Stovepipe" Funding



 DoD espouses cross-program initiatives, but funds stovepiped programs



- Stovepipe thinking is mandated by stovepipe funding
- The Good News! There is some promise of change



## **Rethinking FMS Restrictions**



- Deputy Defense Secretary, Mr. Rudy DeLeon
  - "We have witnessed the beginning of a new era for FMS"
  - "We have to do more than change the mission statement.
     We have to change mindset as well"
  - "Mostly, that difficulty (FMS/data) rests in restrictive licensing procedures required by the government for FMS sales."
- Principal Secretary for Acquisition & Technology, Mr. David Oliver
  - "...export process reform is..number one priority"
- The reality: During the air war in Kosovo, it took more than two months to approve the sale of flares to the Italian Coast Guard for use in the potential rescue of downed allied pilots. (Defense Daily, July 12, 2000)



# FMS - Customers or Partners



- Under the cold war umbrella, allies were considered customers
- Cold war security safeguarded technology and data
- Multi-national defense forces require partnership thinking
- Our FMS customers can become FMS partners if we work to resolve export controls
- Rules must be revised
- Intelligent Partnerships are the wave of the future



## Who is My Partner?



- Intelligent partnering must exist at all levels.
- This will require unprecedented cooperation between:
  - Nations
  - Services
  - Weapons Programs
  - Government and Industry
  - Companies
- Industry has already provided many highly successful examples of joint standards partnership successes
  - Personal Computers
  - Telecommunications
  - Instrumentation and Measurement



#### **GWTS JOIPT**



- GWTS JOIPT was established by NAVAIR with the requirement that it be self-supporting
- The JOIPT has approached this challenge by:
  - Identifying product needs
  - Researching customer needs
  - Developing new customers
  - Establishing Intelligent Partnerships
- JOIPT Members/Participants
  - Taiwan MND, NATO ESSM, NAVAIR/NAVSEA, AF-ATS PGM, AMRAAM JSPO, Raytheon, Support Contractors, COTS suppliers
- The Taiwan GWTS Upgrade Program is an example of a shared program with many direct and indirect benefits



#### **Next Generation Munitions Test Approach**



- Upgrade program is designed to achieve three technical objectives:
  - Replace obsolescent instruments
  - Increase standard interface use
  - Bridge the gap between GWTS and next generation tester
- Embraces three strategic objectives:
  - Apply Industry Consortia standards wherever applicable and affordable (JTA, COTS, etc)
  - Establish and maintain an interface with the weapons users
  - Establish and maintain an interface with the weapons suppliers
- Adapt emerging technologies/architectures



#### **Next Generation Tester Vision**



- Raytheon has:
  - Begun standardization of subassembly ATE
    - Developed Standard Test Equipment Program (STEP)
  - Engaged in a program to standardize Guidance/AUR ATS
    - Leverage current and planned GWTS and STEP technology
- JOIPT is engaged in a multinational, cooperative effort on GWTS upgrade
- The cooperative results of both projects are aimed at providing a common, affordable, interoperable support solution to a wide range of munitions



#### The NxTest Foundation



- DoD's Next Generation Test System (NxTest) relies on industry groups to develop standards
- These groups include:
  - Test & Diagnostics Consortium (TDC)
  - IEEE Standards Groups
  - Interchangeable Virtual Instrument (IVI) Foundation
- NxTest provides Technical Directors from each of the service branches to assist in the "build" of unique service requirements from the NxTest technical foundation
- Service ATE applications can evolve from the standard interfaces and the technical foundation, providing unique-butstandardized solutions with a high level of interoperability
- Replacements for current Standard Family ATS such as CASS and IFTE will be derived from the NxTest architectural environment



#### **Munitions Test Environment**



- GWTS is currently the designated AUR/GS tester for AMRAAM and ESSM, and has also been selected by Taiwan as their standard munitions test system
- The system uses over 95% COTS components with a mix of proprietary and standard interfaces
- It was designed for field use but is also being used in the factory
- The advent of "O-to-OEM" has changed the initial deployment scenario



#### **Next Generation Munitions Test Approach**

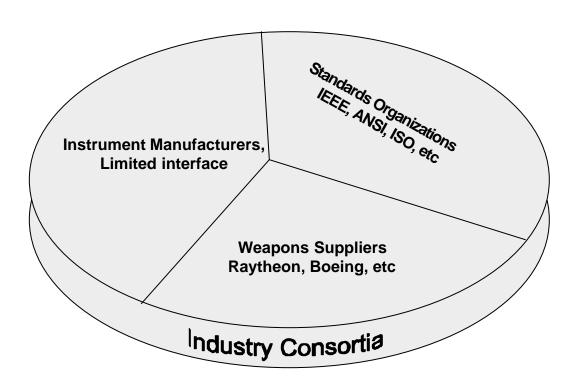


- On-Going P<sup>3</sup>I is designed to achieve two technical objectives:
  - Replace obsolescent instruments
  - Increase standard interface use
- On-going P³I embraces three strategic objectives:
  - Apply Industry Consortia standards wherever applicable and affordable
  - Establish and maintain an interface with the weapons users
  - Establish and maintain an interface with the weapons suppliers
- These objectives are identical to those of NxTest



# **Current GWTS Commercial Base**







## **GWTS Technology Base Assessment**



- Instrument Suppliers Conducted on an ad-hoc basis.
   No formal relationship or established forum
- Weapons Suppliers
  - Good relationship established with Raytheon (major supplier)
    - On-going, cooperative computer H/W and S/w studies
    - CRADA in work
    - Discussions on cooperative development ventures
  - Limited relationship with Boeing
- Standards Organizations
  - Limited activity through IEEE

Conclusion: Technology Base is in formative stages and needs work



# **Current GWTS Participants**



# **Next Generation Guided Munitions ATS GWTS Integrated Product Team** Industry Consortia **TECHNOLOGY BASE**



### **GWTS JOIPT Participants**



- The GWTS JOIPT participants are a mix of:
  - DoD Organizations
    - NAWC-WD Clay Davis
    - NSWC Jon Pieti
    - SA-ALC was Raul Acosta, currently TBD
- DoD Programs
  - AMRAAM JSPO Steve Stanfield Tech Rep
- FMS Programs
  - Taiwan TATE Capt. P. Liao
  - NATO ESSM Wayne Hatcher
- Weapons Suppliers
  - Raytheon J. Lohse, R. Curry
  - Boeing TBD Possible future members
  - LockMart TBD Possible future members



## **NxTest & GWTS Synergy**

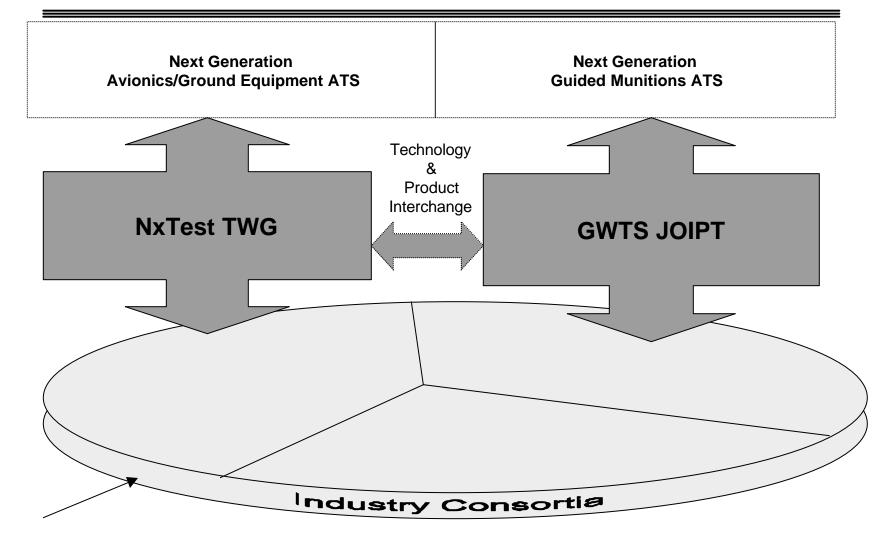


- The missions of NxTest and GWTS are similar in nature
- The participants have common goals which are related, but have some differences at the application level
- Many applications experiences can be shared with mutual benefit
- It is proposed that the GWTS JOIPT work alongside the NxTest TWG, drawing on similar commercial resources and industry standards
- Both groups can operate cooperatively and independently to achieve the ultimate DoD goals of reduced ownership cost and increased interoperability



#### The Vision





**TECHNOLOGY BASE** 



#### **GWTS/JOIPT Status**



- The current JOIPT efforts are based on voluntary, mutually beneficial initiatives
- GWTS has been removed from the Standard Family ATS list based on its non-production status
- The DoD ATS Management Board has recognized the JOIPT effort and recently announced

"... the AMB applauds efforts on the part of the GWTS Joint
Overarching Integrated Product Team and industry toward
development of a future standard test system for all-upround/guidance section testing of a variety of tactical guided weapons
based on emerging technology. Should the DoD develop a
requirement for such a tester, we would welcome the opportunity to
consider the results of this effort for adoption as a DoD ATS Family
Member, assuming that the tester meets the criteria established in
DoD ATS policy for such adoption."



## **Vision Impact**



- The envisioned process allows:
  - Sharing of a common industry test consortia base
  - Sharing of DOD TWG/IPT product and technology resources
  - Common ATS growth under DOD Standard Family ATS management
  - Collaborative efforts aimed at interoperability
- The process does not constrain industry or GWTS but allows for architectural enhancements
- Industry/DOD cooperation eases the transition of factory-to-field-to-factory testing and promotes standardization across test levels and environments



#### **Conclusion**



- Next generation architecture for weapons test is developing today
- Shared research and resources can radically reduce development costs and time-to-market
- Common ATS architectures move us towards maintenance interoperability
- The cooperative effort is voluntary and synergistic. It provides an illustration of Intelligent Partnerships between Industry, government and FMS allies